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GLACIAL EROSION IN THE FINGER LAKE REGION OF CENTRAL NEW YORK[1]

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The origin of the Finger Lake valleys was assigned by Lincoln[2] and by the present writer[3] to glacial erosion upon the evidence of hanging valleys, though this name was not then used. Later recognition of other evidence, notably the steepened lower valley slopes, the smooth, straight valley walls, and the absence of projecting spurs, characteristic of regions of marked glacial erosion, supported this explanation. When, however, quarrying operations revealed an area north of Ithaca in which pre-Wisconsin decay was preserved on the steepened slope of Cayuga valley, it seemed necessary to reconsider the question of the origin of this valley. In a paper presenting the newly discovered facts[4] the general question of the origin of the Finger Lake valleys was reconsidered and three hypotheses were proposed as working hypotheses. No attempt was made to establish either of the hypotheses, but the object of the paper, avowedly an unfinished study, was to show that the problem was less simple than formerly believed, and that there were objections to the glacial-erosion theory of sufficient force to warrant a question whether some other theory than glacial erosion might not account for these valleys. The fact that I have been quoted as an opponent of the glacial-erosion theory for these valleys, which has not been the case, is the reason for this preliminary statement.

One of the three hypotheses considered in my previous paper was stated in the following words:

> A modification of the glacial-erosion theory has been advanced during the progress of the investigation of the problem, and is still being considered. It is as follows: During its first advance the ice deeply eroded the valleys; during

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[2] *American Journal of Science*, Vol. XLIV (1892), pp. 290–301.

[3] *Bulletin of the Geological Society of America*, Vol. V (1894), pp. 339–56.

[4] *American Geologist*, Vol. XXXIII (1904), pp. 271–91.

interglacial conditions the older gorges were cut; with return of glaciation the valleys were deepened still further. During as many glaciations as this region experienced this process was continued. On this basis the older gorges are interglacial; their cause is the lowering of their base level by the overdeepening of the valleys to which they were tributary. Since facts sufficient to establish or to overthrow this explanation are not yet at hand, it must stand at present merely as a working hypothesis.[1]

Work done since the publication of this paper strongly supports the theory of double glacial origin for at least the Seneca valley. In this valley there is a general condition of remarkably perfect, broad, mature tributary valleys hanging several hundred feet above the lake level, at about the 900-foot contour. They are truncated by the straight, smooth, lower steepened slope of the main valley, so that they stand out prominently, with open mouths, clearly discordant with the main valley, and about 1,500 feet above the rock floor of the Seneca valley at Watkins.

These hanging valleys are trenched in their bottoms by gorges partly buried in Wisconsin drift. The buried gorges are both broader and deeper than those of postglacial origin. Along the western shore of Seneca Lake from Watkins to the northern edge of the Watkins topographic sheet, a distance of eight miles, there is absolutely continuous rock, proving that the gorges have not cut below lake-level. Yet the rock-floor of the main valley is 1,000 feet below lake-level at Watkins. The gorges are therefore also hanging valleys, and a double period of glacial erosion is indicated, with an intermediate condition of interglacial stream erosion.

On the eastern side of the Seneca valley the evidence is almost as clear, though there are some short gaps in the rock-wall. In the Cayuga valley there are gaps in the rock which may possibly be on the sites of the buried gorges, so that the evidence from this valley is not convincing.

In my previous paper it was pointed out that there is a marked discordance in the hanging valley levels of neighboring valleys, and this fact was then considered to be evidence opposing the glacial-erosion theory. Both Salmon and Six Mile Creek valleys hang at a much lower level than their neighbors (for example, Fall, Cascadilla, and Buttermilk (Ten Mile)). I am now convinced that the interpretation that this discordance is opposed in the glacial-erosion theory was incorrect, and that these two valleys are really confirmatory of the glacial-erosion theory. This change of view is the result of a recent study of the valley profiles and a mapping of the moranic deposits of the valleys in question. The latter show that these valleys were occupied by actively moving ice parallel to their axes, while the neighboring higher hanging valleys were not. They were therefore open to ice-scouring. A study of the profiles shows that these discordant hanging valleys have the U-shape of glacial erosion and not the gorge-shape of a rejuvenated valley, the only other explanation that seems a possible one for such discordance. It is believed, therefore, that while the Cayuga valley was profoundly deepened by ice-erosion, the Salmon and Six Mile Creek valleys were deepened moderately, and the Fall, Cascadilla, Buttermilk, and other valleys practically not at all, since they were not occupied by ice freely moving along their axes.

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[1] *Ibid.*, p. 284.

There still remains some evidence opposing glacial erosion by the Wisconsin ice-sheet, but none opposing erosion by an earlier advance, unless the fact that no deposits of an earlier ice-advance are found in this region is considered opposing evidence. The most serious objection to Wisconsin ice-erosion is the presence of residually decayed rock at the Portland quarry north of Ithaca. But in view of the striking topographic evidence of ice-erosion of a double period—the condition of double hanging valleys, the steepened slope, the spurless valley wall, and the undissected valley sides—the question may fairly be asked whether even this evidence from residual decay remnant, in a single place, may not be misleading. In seeking for an explanation of the presence of this decay product in the particular place where it occurs, I have found but one hypothesis that appears possible. The Portland quarry lies just south of the junction of Cayuga Lake and Salmon Creek valleys, down both of which the ice flowed somewhat freely. It is possible that the thrust from the Salmon Creek valley pushed the ice toward the west side of the Cayuga valley, leaving the site of the Portland quarry under a wedge of ice with slight motion, and hence with slight erosive power. Too little is known about the erosive action of ice, and the direction of ice-currents under the guidance of topographic irregularities, to warrant further consideration of this question, at present.

To account for the facts briefly outlined in this paper by rejuvenation seems utterly impossible. This hypothesis will not explain the hanging gorges, nor the discordant U-shaped hanging valleys. Formation of the lake valleys entirely by Wisconsin ice-erosion is also out of the question. But the striking resemblance of the topography to that of regions of known ice-erosion seems to demand origin by glacial erosion; and, in spite of the opposing evidence from a remnant of residual decay, and of other objections of less importance, it is believed that such an origin must be assigned to these valleys, and that the apparent objection to such origin is dependent upon some local condition which permitted residually decayed rock to remain, while elsewhere in the valleys there was profound ice-erosion.